STONE ENVIRONMENTAL

Removing Dissolved Phosphorus from Tile Drain Water

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Agricultural Drainage and Phosphorus

Agricultural drainage typically consists of a network of ditches, often augmented by tile drains

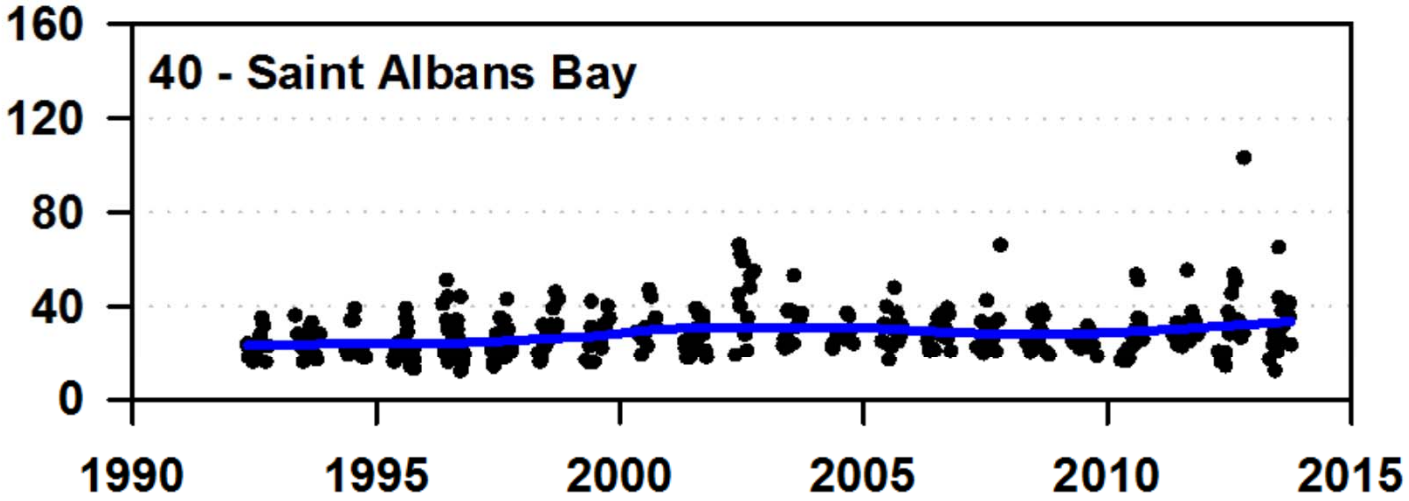
- Installing tile drainage may reduce Phosphorus (P) loading in some situations and increase it in other situations

Past conservation efforts have focused on controlling P loading by reducing erosion in surface runoff

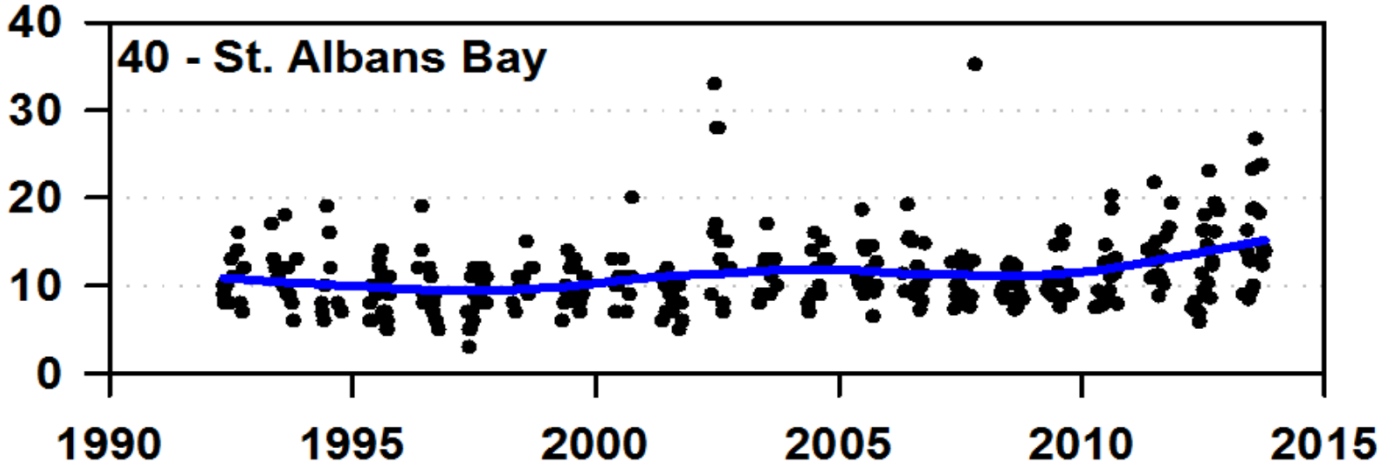
Most P monitoring and reporting has focused on Total Phosphorus (TP)

- Trends in soluble P (TDP) have been largely ignored
- Contributions of soluble P from tile drainage has also been largely ignored

Trends in TP and Soluble P (TDP) in St. Albans Bay



Total Phosphorus (TP) Concentrations (a 7% increase over last 5 years)



Soluble Phosphorus (TDP) Concentrations (a 20% increase over the last 5 years)

Source: VTDEC LC Long-term Monitoring Program

Study Objectives

Construct a phosphorus removal system at the outlet of a tile drain

- Compare two treatment media

Determine phosphorus removal efficiency of the media

- Monitor flow volume
- Sample for phosphorus (TP, TDP) at inflow & outflow
- Calculate total P removed from system

Share results

Site in Franklin, VT

Study Farm Characteristics

- Small dairy farm
  - Milking ~120 cows
- Soybean/corn strips on field
- Tile drainage system drains about 35 acres
- Tile discharges into a ditch on the west side of the field

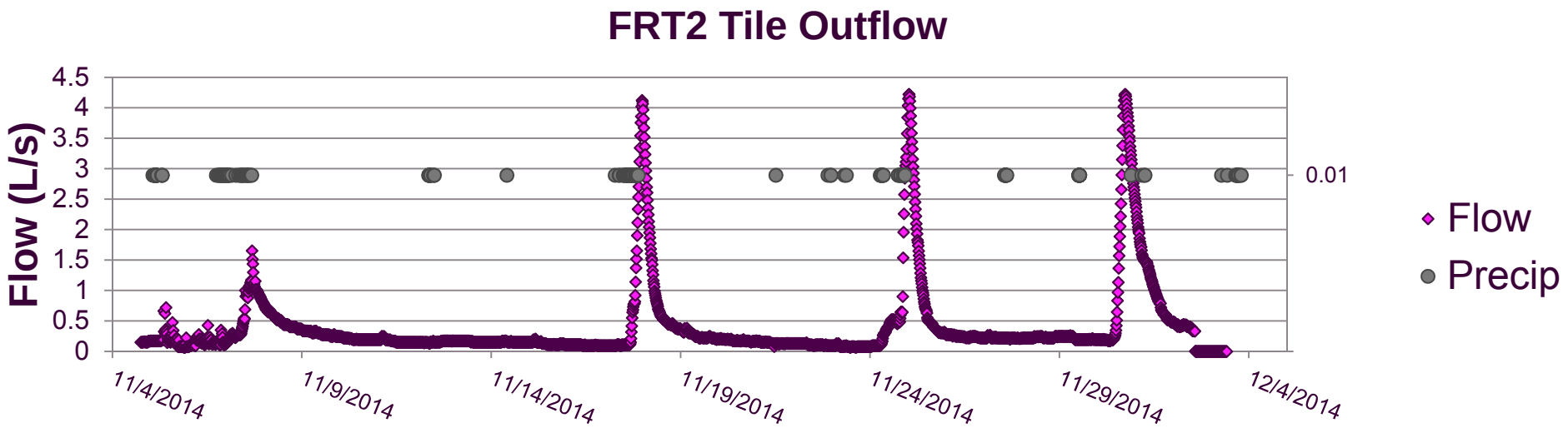
Tile Drain System Characterization

Flow and precipitation were monitored Oct 20-Dec 3, 2014

- 4 precipitation events captured
  - 0.29-0.60 inches of rain during events

Range of peak flows and event volumes

Phosphorus concentrations ranged from 104-450 µg/L; median = 286 µg/L



Media Selection

Criteria:

- Effective P removal
- Ability to pass water (e.g., “hydraulic conductivity”)
- Locally sourced
- Inexpensive
- Simple, safe disposal

Worked with researchers at UVM and Oklahoma State to evaluate a variety of media including:

- Drinking water treatment residuals (DWTR)
- Limestone products/tailings (Swanton, Shelburne, Florence)
- Gypsum (Milford, NS)
- Wollastonite (Willsboro, NY)

Ultimately selected: DWTR and Swanton limestone

Filtration Media #1 – Drinking Water Treatment Residuals

DWTR (also “backwash residuals”) are coagulated materials filtered from drinking water

- Local source
  - Water extracted from Lake Champlain
  - Processed by the Champlain Water District facility in South Burlington
- Excellent phosphorus removal capacity
  - Alum used as a coagulant
  - Performed best of all materials in UVM lab tests
- Safe disposal
  - Can be land-applied at the end of the study

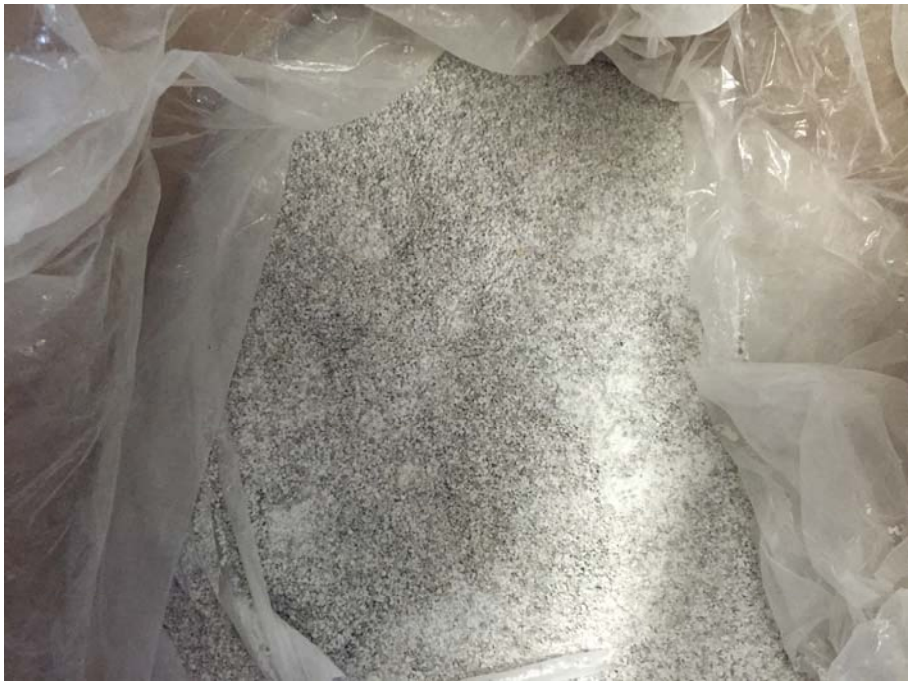
Filtration Media #2 – Bedding Sand

Limestone materials from several local facilities were evaluated by researchers at UVM and Oklahoma State:

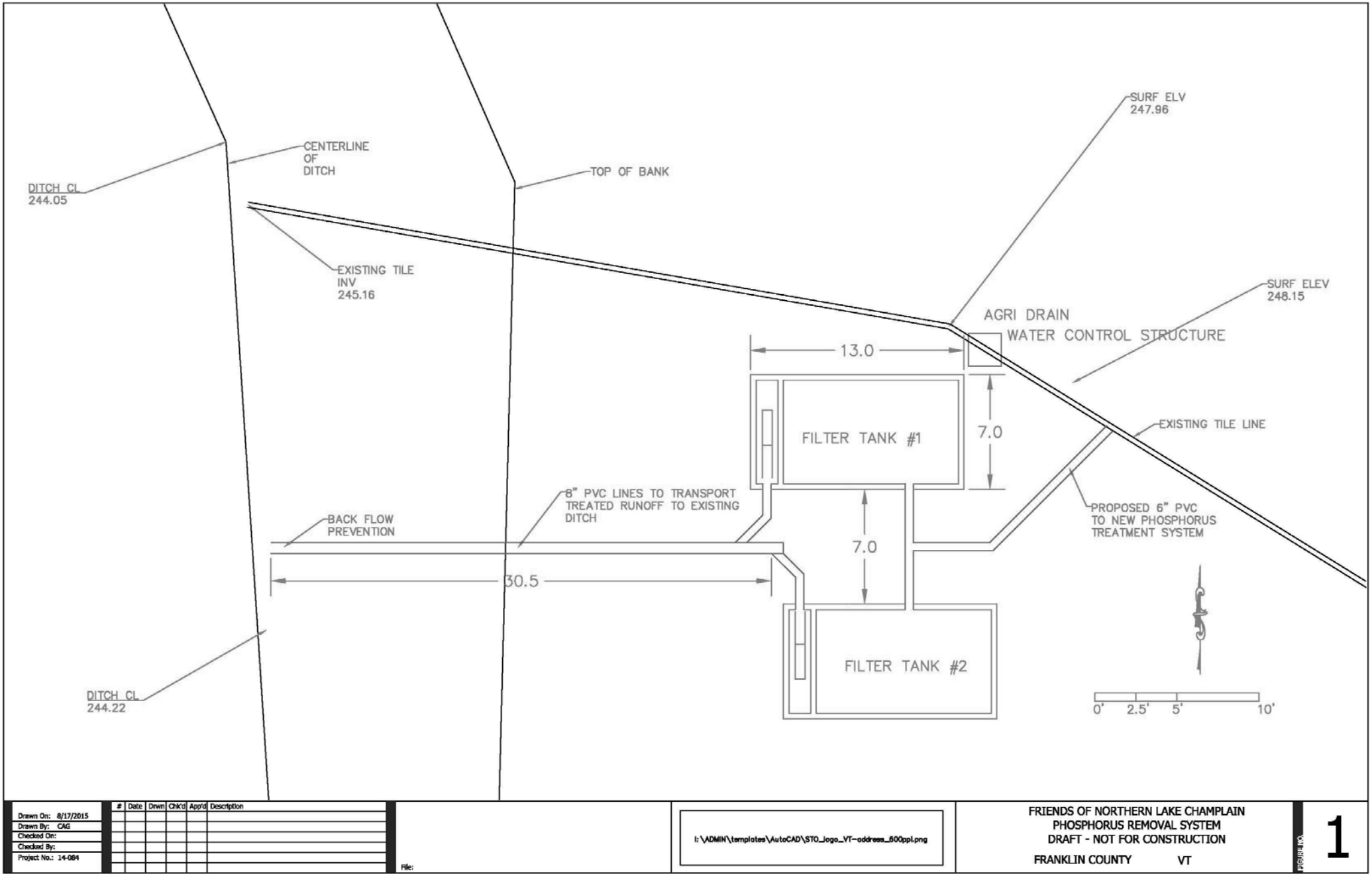
- M&T Sand and Gravel in Swanton, VT
- Shelburne Limestone Corp.
- OMYA, Florence, VT

Bedding sand from Swanton facility was selected

- Good phosphorus removal capacity
- Appropriate hydraulic conductivity



Phosphorus Removal System – Design



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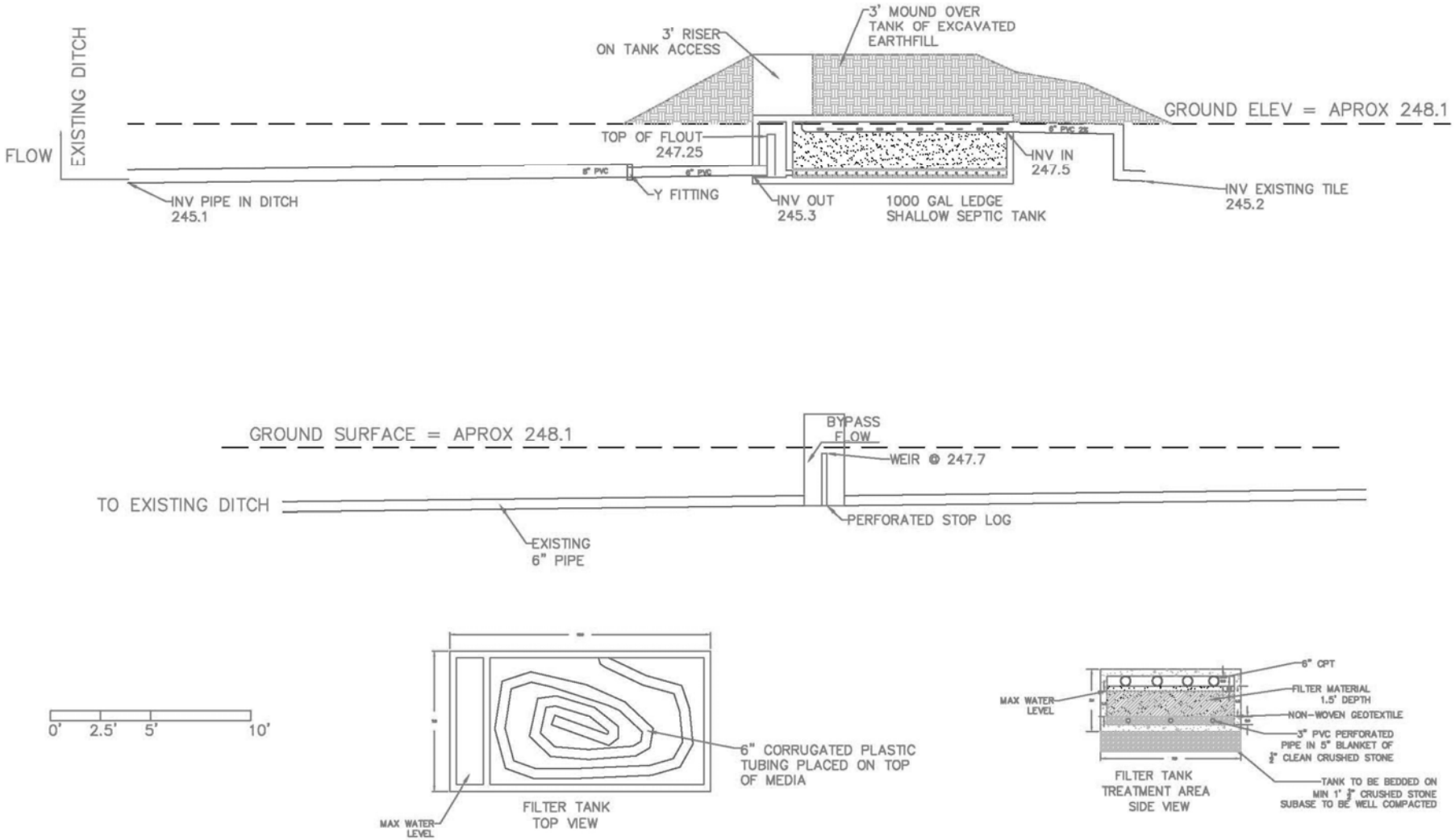

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FRIENDS OF NORTHERN LAKE CHAMPLAIN
PHOSPHORUS REMOVAL SYSTEM
DRAFT - NOT FOR CONSTRUCTION
FRANKLIN COUNTY VT

FIGURE NO. 2

System Installation

System Installation

System Installation

System Installation

Preliminary Results

Tile hydraulics are more complicated than we expected.

Both media are reducing P concentrations.

- DWR: ~70% of TDP
- Limestone: <40% of TDP

Neither media is having an effect on N.

Both filters can function as a sediment filter (not good).

Ongoing and Future Work

Monitoring of existing system

- Data collection and analysis will continue for 12-18 months
- Site will be maintained on a monthly basis
- Farm will be managed as normal
  - Spring manure application

Photo: Chad Penn, OK State

Opportunity to “swap out” media and take advantage of monitoring infrastructure to evaluate additional treatment media

Monitoring of 12 tile drain systems in the Jewett Brook watershed to start in late 2016

- Provides some opportunity consider different management measure over tile

Development of in-ditch treatment systems?

Acknowledgements

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